PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO SPHERICAL PLUG COCKS

(71) We, ISTAG A. G. SUHR/AG, a Body Corporate organised under the Laws of Switzerland, of 363, Hint. Dorfstrasse, Suhr, Aargau, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a plug cock having a spherical plug which it rotatably mounted to be able to connect inlet and outlet passages in the cock body, the plug being engaged by rings at the openings of the inlet and outlet passages.

In the majority of such plug cocks the sealing is effected in that the ball plug is forced by the action of the fluid medium against the ring situated on the low pressure or downstream side and thus seals with that ring. In recent years, there has been an increasing demand, that in such spherical plug cocks an additional seal should be obtained by the sealing element on the high pressure side. The known designs which meet this requirement utilise rings of synthetic or similar materials in the cock body, these having a flexible portion, e.g. a lip, held in contact with the plug by the assembly stress so that on the high pressure side the inlet pressure acts to urge the flexible portion into contact with the ball and assists the seal. A major portion of each ring then serves for seating the ball plug; the ring on the low pressure side, i.e. the downstream ring performs this function and at the same time effects the seal on this side. Since the plug is forced, when subjected to pressure, against the ring on the low pressure side until the resistance thereof against deformation is high enough, the flexible portion of the ring on the high pressure side must yield to such a degree that it follows this movement of the ball in order to maintain the fluid seal on the high pressure side. The material of the rings accordingly must have on the one hand the required yield characteristics and, at the same time, it should sufficiently resist deformation to effect a seating of the ball on the low pressure side without an excessive displacement of the ball. Since such rings have to seal under various pressures, these diverging requirements often cannot be fulfilled. Furthermore, the known single piece sealing elements are of a relatively complicated shape, and the flexible parts are highly stressed, because they are subjected to considerable deformation as compared with their relatively small dimensions.

It is an object of the invention to provide an improved plug cock which will avoid the disadvantages of the cocks mentioned above in effecting a seal on the high pressure side.

According to the invention, respective ring-form sealing engagement devices are provided on the upstream side and on the downstream side of the ball plug, each engagement device comprising a seating ring for the ball, and a separate sealing ring that is in the form of a dished spring in its unstressed condition, the sealing ring being arranged on the side of the seating ring axially further from the ball plug centre, a radially outer region of the sealing ring being arranged to seal against the cock body and a radially inner region being urged against the ball plug to effect sealing of the ball plug on the upstream side, the ring being stressed during assembly by the sealing engagements of said radially inner and outer regions which apply axially opposite forces to said regions of the ring tending to reduce or remove its conicity.

In operation, the cock is sealed on the high pressure side by the sealing ring and on the low pressure side by the seating ring. These rings can be designed for their different functions, i.e. the sealing rings can be given the correct dimensions and can be made of the correct material for obtaining an efficient seal and a high flexibility, while the seating ring can be made so that it yields as little as possible. The ball is thus subjected to only limited axial movements in use, even at widely differing pressures, so that the sealing rings are little stressed by the fluid pressure. A construction according to the invention can offer an additional safeguard if the inner edge of the sealing ring

[*Price 5s. 0d. (25p)*]

should be damaged since this will continue to press against the seating ring and the two together effect a certain, though usually incomplete, seal.

Preferably, the outer region of the sealing ring is cylindrical when in an unstressed condition and effects a seal in conjunction with a cylindrical recess in the cock body. In the prestressed condition of the ring, i.e. upon compression of the conical shape, the outer region bears under tension against the cylindrical recess and thus effects a stable seal. If the sealing ring is thickened towards its outer edge an additional bending deformation can be imparted to the ring on the low pressure side towards the region of its inner edge when it is prestressed.

The sealing ring may be made of many different materials, including metal, and it can be arranged to be completely flat in its pretensioned built-in condition, or to retain some of its conicity. However, it is important that the change of the conicity does not exceed a maximum value dictated by the material used such that no permanent deformation is caused. Advantageously the sealing ring is of p.t.f.e. and the modification of its conicity between the unstressed and pretensioned condition is in the range of 2° to 15°, preferably 5° to 10°.

For higher fluid operating pressures, it is advantageous if each seating ring is axially displaceable in the body, since this then permits the sealing ring on the high pressure side to move freely and follow the displacement of the ball caused by the pressure, yet nevertheless to act as a support for the sealing ring against the pressure. The seal on the low pressure side between the body and the seating ring is then completed by the sealing ring being clamped between these parts. For particularly high operating pressures, it is advantageous if the mobility of the seating ring is limited by an abutment that will restrict compression of the sealing ring to a predetermined value. It is thereby possible to avoid overstressing the sealing ring on the low pressure side, to avoid damaging this ring and to limit axial movements of the ball plug. The abutment can be provided either on the body wall or on the seating ring. If that face of the movable seating ring remote from the ball plug is in a plane perpendicular to the axis of the cock, the sealing ring on the low pressure side is pressed completely flat, so that, as previously mentioned, provision is made for the sealing ring to be bent by the ball instead of being compressed at its radially inner region and permanently deformed. However, it is also possible to form the seating ring in such manner that the face remote from the ball plug has a conicity that inclines towards the ball plug whereby the sealing ring on the low pressure side can be given sufficient clearance without requiring additional bending of its radially inner region.

The seating ring can be designed to be resistant to deformation under operating conditions and may comprise a metal construction having good antifriction properties.

The invention will now be more particularly described with reference to the examples illustrated in the accompanying drawings, wherein:—

Figure 1 shows a spherical plug cock according to the invention in axial section;

Figures 2 and 3 illustrate seating and sealing rings on the low pressure side of two alternative modified spherical plug cocks according to the invention; and

Figure 4 shows a further plug cock according to the invention having a three-part body.

The spherical plug cock shown in Figure 1 comprises a two-part body or casing 1 which encloses a ball plug 2. This plug is operable by an actuating stem 4 which is sealed towards the outside by means of an O-ring 3. The plug 2 is guided in the casing by seat rings 5 which are held against axially outward movement by shoulders 6 provided in the casing. Adjacent the face of the seat rings turned away from the plug, dished spring sealing rings 7 of p.t.f.e. (polytetrafluorethylene) are inserted into the casing. The sealing rings are pretensioned when the cock is assembled, i.e. due to being compressed by the ball plug they are flattened with respect to their unstressed conical shape directed towards the ball plug. Thus, the rings 7 are held by their outer radial regions with pressure against the casing and at the same time by their inner radial regions bear against the plug; this pressure increases correspondingly on the high pressure side, i.e. on the upstream sealing ring upon admission of pressure fluid to the cock and thus the sealing effect is enhanced by the increased fluid pressure. The spherical plug cock according to the invention is represented as having the pressure admission on the right-hand side; on the low pressure side the downstream seat ring effects a seal by bearing against the shoulder 6. The seat rings, in such a construction, preferably consist of a reinforced plastics material, for example of a filled p.t.f.e., so that the movement of the ball plug due to deformation remains as small as possible. The sealing ring on the low pressure side is slightly more biased than the sealing ring on the high pressure side, but is not pressed to be completely flat.

Figure 2 is a fragmentary view of a modified spherical plug cock according to the invention and shows a sealing ring and associated seat ring on the downstream side

of a cock construction for higher operating pressures, pressure fluid admission being again effected from the right-hand side. The seat ring 10 consists of an annular metal body which is provided with a ring of plastics material 11 inserted into the surface facing the ball plug, this ring being preferably of p.t.f.e., which arrangement results in a relatively small frictional resistance. On the low pressure side the inner edge of the sealing ring 12 bears sealingly on the ball plug, the radially inner region of the ring 12 being deformed by the pressure of the ball plug. The seat ring 10 bears against the sealing ring 12, so that at the outer radial region of the ring 12 a seal is obtained to complete the sealing of the low pressure side. The seat ring which is guided in the same bore in which also the sealing ring is inserted. is provided with a shoulder 14 at its end directed towards the ball plug pivot axis, which shoulder co-operates with an annular face 15 on the casing 16. This shoulder prevents the seat ring from moving too far in the direction towards the sealing ring, whereby excess pressure on the sealing ring and damaging thereof is avoided. The sealing ring is provided with a thickened portion towards its outer rim. so that there is an annular space in which the radially inner portion can be deformed by the pressure of the plug. If the sealing ring is to be of constant thickness, this effect could also be obtained by recessing the wall of the bore in the casing to the shape indicated by dotted lines.

Figure 3 shows the sealing and seat rings on the downstream side of a further embodiment of spherical plug cock according to the invention, in which the sealing ring is not pressed flat. The thickness of the sealing ring 20 is so dimensioned that the outer rim of the ring slightly projects beyond the shoulder 21 provided between the two bores for the sealing ring and the seat ring. The seat ring 22 which in this case consists of a metal ring coated with plastics material, is supported by a flat outer portion of its end face bearing on the sealing ring, whereby the seal on the low pressure side is effected. The major portion of the end face 23 of the seat ring 22 facing the sealing ring is provided with a conicity directed towards the ball plug and thus does not interfere with deformation of the sealing ring that results from the pressure of the plug in the same manner as the embodiment of Fig. 2. With the constructional examples of Figures 2 and 3, the manner of sealing on the low pressure side has been described in each case in some detail but these respective arrangements effect sealing on the high pressure side in the same manner as in the example described with reference to Figure 1 and further explanation is therefor unnecessary.

In the spherical plug cock represented in Figure 4, the sealing and seat rings are inserted in a middle part 30 of the casing in which also is mounted an actuating stem 32 for ball plug 33, which stem is sealed by an O-ring 31. In this construction the seat rings 34 are inserted in the through bore provided for the ball plug in the middle part 30 of the casing, while the sealing rings 35 of p.t.f.e. seal against the greater diameter of recesses 36 in the end faces of the part 30. Each recess is so dimensioned that when assembling the two casing ends 37 (which are drawn together by tensioning screws, not shown) at the same time a sealing of the casing joints between the middle part and the end parts thereof is obtained by the sealing rings 35. The seat rings 34 which consist of filled plastics material or graphite, are practically fixed owing to being clamped between the ball and the end faces 38 of the sealing rings. The end faces 39 of the seat rings 34 have a conicity which is directed towards the ball and a space of wedge-shaped cross section is formed between the opposite end faces of the seat rings and the sealing rings, so that the sealing rings can always freely deform and seal in the manner as described above with reerence to the other examples.

WHAT WE CLAIM IS:—

1. A spherical plug cock having a ball plug which is rotatably mounted in a body of the cock and sealing against ring-form engagement devices surrounding the openings of the inlet and outlet passages to the plug, each said engagement device comprising a seating ring for the ball, and a separate sealing ring that is in the form of a dished spring in its unstressed condition, the sealing ring being arranged on the side of the seating ring axially further from the ball plug centre, a radially outer region of the sealing ring being arranged to seal against the cock body and a radially inner region being urged against the ball plug to effect sealing of the ball plug on the upstream side, the ring being stressed during assembly by the sealing engagements of said radially inner and outer regions which apply axially opposite forces to said regions of the ring tending to reduce or remove its conicity.

2. A spherical plug cock according to Claim 1 in which said outer region of the sealing ring is cylindrical in the unstressed condition and effects a seal in conjunction with a cylindrical recess in the cock body.

3. A spherical plug cock according to Claim 1 or 2, in which the sealing ring is thickened towards its outer edge.

4. A spherical plug cock according to any one of Claims 1 to 3, in which the sealing ring is of p.t.f.e., the alteration in the conicity of the dished spring between its pre-assembly

and its stressed, assembled condition being between 2 and 15°.

5. A spherical plug cock according to any one of Claims 1 to 4, in which each seating ring is arranged to be axially displaceable in the body.

6. A spherical plug cock according to Claim 5, in which the axial movement of the seating ring is limited by an abutment permitting a predetermined maximum compression of the sealing ring.

7. A spherical plug cock according to Claim 6, in which said abutment is formed between a first recess for the sealing ring and a second recess for the seating ring of greater diameter than the first recess.

8. A spherical plug cock according to Claim 6, wherein the seating ring has a portion adjacent the sealing ring of the same outer diameter as the sealing ring and has an element providing said abutment at a portion remote from the sealing ring.

9. A spherical plug cock according to Claim 7, or 8, in which the end face of the seating ring remote from the ball plug is in a plane perpendicular to the axis of the cock.

10. A spherical plug cock according to any of Claims 1 to 8, in which the end face of the seating ring remote from the ball plug is conical and tapers radially inwards towards the ball.

11. A spherical plug cock according to any of the Claims 1 to 10, in which the seating ring is of a filled plastics material.

12. A spherical plug cock according to any of Claims 1 to 10, in which the seating ring is of metal coated with a plastics material.

13. A spherical plug cock according to any of Claims 1 to 10, in which the seating ring comprises an annular body of metal having a ring of plastics material providing a contact surface with the ball plug.

14. A spherical plug cock according to any one of Claims 11 to 13 wherein the plastics material is p.t.f.e.

15. A spherical plug cock constructed and arranged substantially as described herein with reference to any one of the figures of the accompanying drawings.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig. 1

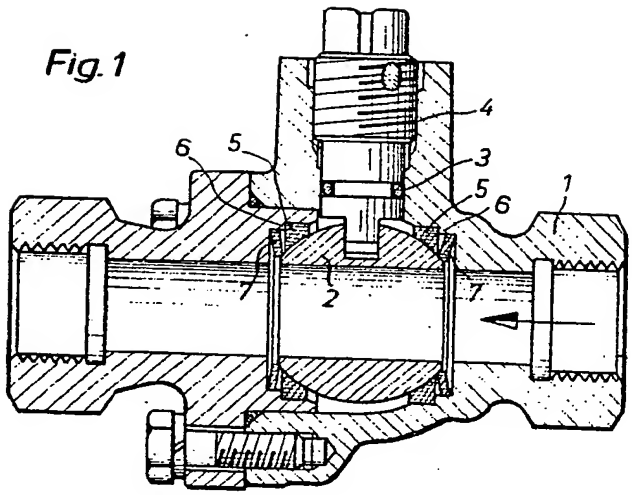

Fig. 2

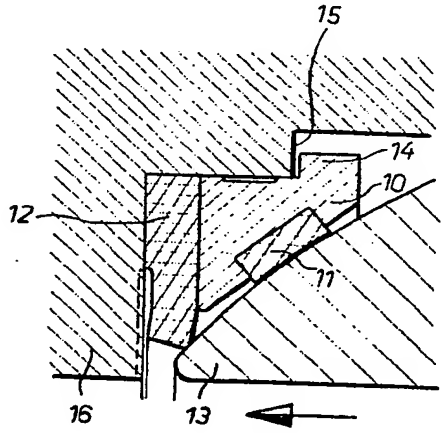

Fig.3

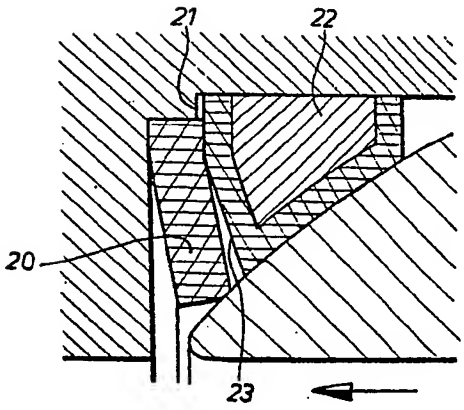

Fig.4